

REMARKS

In response to the Official Action, the present Amendment modifies claim 1 to incorporate the subject matter of claim 2 and such claim, as well as claims 17, 20 and 24, have been canceled without prejudice or disclaimer. Accordingly, the present Amendment does not raise any new issues or require further searching while reducing the number of claims of record and is thereby believed to be proper in all respects.

As now recited in claim 1, one aspect of the present invention relates to a polyimide compound crosslinked with polyamine which is soluble in a solvent containing aprotic polar organic solvent, wherein the polyimide compound is obtained by dehydration and condensation of amino acid or salt thereof in the presence of polyamine and protonic acid in the solvent containing aprotic polar organic solvent and 0.05 to 10 mol% of the polyamine is used with respect to the amount of the amino acid or salt thereof, and wherein a concentration of the obtained polyimide compound in the reaction mixture is 5 to 80% by weight and wherein the polyimide compound is soluble in the solvent containing the aprotic polar organic solvent in a concentration of 5% by mass or more at 25°C.

On considering the invention defined in claim 1, It is important to recognize several aspects of the claim. In particular, the claim recites that the crosslinked polyimide compound of the present invention is obtained by the dehydration and condensation of amino acid or salt thereof in the presence of polyamine and protonic acid in the solvent containing aprotic polar organic solvent. In other words, the polyimide compound is prepared in the presence of the solvent containing the aprotic polar organic solvent and the polyamine, such as illustrated in the Examples. Furthermore, the claim defines the ratio of polyamine to amino acid or salt thereof

and recites that the concentration of the obtained polyimide compound in the reaction mixture is 5 to 80% by weight. These recitations help ensure that a polyimide compound of relatively high molecular weight can be obtained that is crosslinked, but which is still soluble as evidenced by the further recitation in the claim that the polyimide compound is soluble in the solvent containing the aprotic polar organic solvent in a concentration of 5% by mass or more at 25°C.

The significance of the claimed features is reflected in the illustrative Examples which provide polyimide compounds that can be dissolved in N,N-dimethylformamide and passed through a filter. The Comparative Examples show that when the present invention is not followed, inferior results are obtained. For instance, as shown in Comparative Example 4, when the polyamine is used in an amount greater than that recited in claim 1, gelling occurs and the claimed solubility could not be achieved. Thus, it can be understood that the conditions recited in claim 1 have an effect on the final product.

Applicants respectfully maintain that the claims previously of record were patentable over the combination of Lepage, U.S. Patent No. 5,824,765, and Harada et al., U.S. Patent No. 5,686,066, but that the claims now of record are unquestionably patentable over this prior art. As explained in the previous response, Lepage relates to the preparation of polycondensates of amino acids or of polypeptide hydrolysates thereof. The process involves bulk thermal polycondensation of amino acids in a pulverulent medium in the presence of phosphoric acid, phosphorous pentoxide or polyphosphoric acid catalyst which is uniformly distributed in the pulverulent medium. To underscore this understanding, the Examiner's attention is respectfully directed to the opening line of each of Examples 1-8 which reads: "A **pulverulent** mixture is prepared by:" (emphasis

added). Furthermore, it will be noted that Comparative Examples 9 and 10 do not use a pulverulent mixture and report inferior results compared to the illustrative examples.

In view of the foregoing discussion, it is without doubt that Lepage does not meet the recitation in claim 1 that the polyimide compound is obtained by dehydration and condensation of amino acid or salt thereof in the presence of polyamine and protonic acid in the solvent containing aprotic polar organic solvent. In this latter respect, the Examiner's reference to an aprotic polar organic solvent on page 2 of the Action, is inapposite. This passage of the patent only refers to the purification of the formed polyimide. This understanding is apparent from the passage at column 3, lines 21-31 which reads:

The polyimide obtained according to the process of the invention may, if necessary, be separated out, filtered off, purified and dried.

The catalyst may, if desired, be separated from the polyimide by washing with water or using a solvent for the catalyst which is a non-solvent for the polyimide.

The polyimide may be purified by solubilization using a polar aprotic solvent (dimethylformamide, formamide, dimethyl sulphoxide, etc.) followed by reprecipitation using a non-solvent compound for the said polyimide (water, ether, ethanol, acetone, etc.).

Indeed, by requiring a pulverulent mixture, Lepage would actually lead away from the recitations in the claims that the polyimide compound is obtained by dehydration and condensation of amino acid or salt thereof in the presence of polyamine and protonic acid in the solvent containing aprotic polar organic solvent.

Lepage is also deficient by failing to specifically teach a crosslinked polyimide. With regard to the discussion at column 2, lines 34-41, this passage only mentions the possibility of a mixture of aspartic acid or glutamic acid and no example of

patent uses such a mixture.¹ Moreover, if one were to crosslink in the required pulverulent mixture, one would likely have a higher degree of crosslinking due to the higher concentration of amino acid which would result in a polysuccinimide that would not meet the solubility now recited in claim 1.

As a still further point of consideration, Lepage is seeking an entirely different goal compared to the present invention. Instead of seeking a crosslinked polyimide, the patent is attempting to reduce the amount of phosphorus pentoxide or polyphosphoric acid without formation of foam and without the reaction medium setting to a solid (column 2, lines 1-13).

Further demonstrating the disparate nature of the present invention over Lepage, is the fact that while the patent requires phosphoric acid, phosphorus pentoxide or polyphosphoric acid catalyst, it can be ascertained from a review of the specification and Examples 1-3 of the present application that such materials are not necessary in obtaining the advantageous results that can be attained in accordance with the present invention. Accordingly, it is without question that the claims of record are patentable over the fair teachings of Lepage.

Harada et al. has been cited to show that an aprotic solvent, such as dimethylformamide, is a good solvent for polysuccinimide. This disclosure does not add anything to the aforementioned description in Lepage that the formed polyimide can be purified by solubilization in a polar aprotic solvent. The Examiner' statement on page 3 of the Action that based on this description one would be led to using such a solvent in the polycondensation reaction is not based on the actual teachings of the patents, but rather on a hindsight justification based solely on applicants' own teachings which of course is improper. Furthermore, such a hypothetical

¹ Applicants note that on page 7 of the previous response, the word "not" was inadvertently omitted so that the sentence should have read: " It is without question that Lepage does not describe the defined polyimide compound crosslinked with polyamine."

combination would not be proper since it would be directly contrary to the requirement of Lepage to use a pulverulent medium.

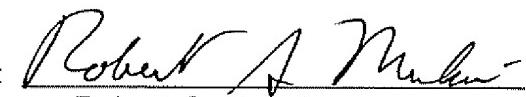
As a still further reason why the claims are patentable over the combination with Harada et al., is the fact that the patent would actually lead those of ordinary skill in the art away from the present invention by teaching in the passage beginning at column 13, line 9, that the polysuccinimide can be reacted with at least one diamine compound or amphoteric amine compound which is different from the claimed polyimide which is prepared in the presence of the polyamine so as to obtain a crosslinked polyimide that is still soluble in the solvent containing the aprotic polar organic solvent as recited in claim 1. Thus, the additional reliance on Harada et al. would not lead those of ordinary skill in the art to the presently claimed invention and, if anything, would lead away from the present invention.

For all of the reasons set forth above, applicants respectfully submit that the claims now of record are patentable over the cited prior art and therefore request reconsideration and allowance of the present application.

Should the Examiner have any questions concerning the subject application, the Examiner is invited to contact the undersigned attorney at the number provided below.

Respectfully submitted,

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